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An Econometric Analysis

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PENSION REFORM AND FINANCIAL MARKETS IN MEXICO
AN ECONOMETRIC ANALYSIS

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ABSTRACT

In this paper we analyse the implications for the Mexican financial system of substituting the Pay as you go pension system by a private Fully Funded scheme. With that aim, we begin by applying the Standard ADF test, in order to test each variable for the presence of a unit root relation. This test are required to validate the use of the cointegration technique of the Engle-Granger two-steps cointegration methodology, which has the advantage of distinguish a long-term OLS regression and an Error Correction Model for the short-term dynamics. We found that higher pension assets are associated in the long-run with financial savings, which is consistent with the fact that pension fund may act as a institutional investors managing the increased personal savings. With respect to the banking industry, a negative long-run relationship was found. This negative sign can be explained by the declining trend on the credit provided from commercial banks to the private sector and the rise in importance of other financial intermediaries

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PRELIMINARY VERSION

COMMENTS WELCOME

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1 Introduction

One of the consequences of the increased longevity of world population, caused by the rise in life expectancy and the decline in the fertility rate, is the financial collapse of many pension systems.[1] Growing benefits and rising dependency ratios have made most of the existing pension systems unsustainable. As a result of this global ageing process, retirement schemes have become ineffective for providing adequate old-age saving, insurance and to make appropriate distributions.

The existing pension systems were originally created on the basis that there were enough participants in the next generations to support current participants, (a pyramidal scheme). These pension systems pay "defined benefits", which are defined according to a formula based on the worker's earnings and years of service and are financed by payroll taxes on a pay-as-you-go (PAYG) scheme. Under this system the government, acting as trusted agent, collects funds from current workers and allocates them to current retirees.

The survival of this scheme, in a context of increased longevity, requires governments to take drastic measures. In other words, for the existing system to provide the same benefits as before, taxes must increase drastically or else governments will run large unsustainable deficits. Less drastic measures have also been suggested to tackle with this problem. Those measures include increases in the retirement age and raising the current contribution made by workers[2]. Unfortunately, as a result of the current fall in fertility rates, these measures are not sufficient to deal with pension benefits problems in the long run.

In light of this, a structural reform of the pension system can be seen as the way the governments found to attacking the aging population problem. As a result pension reforms have been taking place in many countries around the globe, from Latin America to OECD countries and many developing countries in Europe and Asia[3].

More often than not, this reform implies the change from an (unfunded) PAYG state run system to a "defined contribution" Fully-Funded (FF) private scheme. A "defined contribution" FF scheme has a self-insurance basis, which involves people saving for their retirement, with the money being deposited in individual accounts. These are privately managed accounts that require a mandatory monthly deposit, whilst allowing for voluntary deposits if the holder of the account is interested.

[1] According to UN Figures, the number of persons aged 60 years or over around the world is expected to triple by 2050; in contrast, the number of children (0-14 years) will change little over the next 45 years, their share of the total population will drop from 28% to 20%. In addition, by 2050, most of the aged population will live in the developing world.
[2] Chile, Germany and Japan increased their statutory retirement age from 65 to 67 years.
[3] For a complete summary of pension systems and reform dates across the world, see Hu (2005).

Most people believe that the shift from a PAYG system to a private FF scheme would increase economic welfare of the population, through rises in efficiency. Privately managed pension plans are likely to be invested in a mixture of public and corporate bonds, and managed wisely, producing a better allocation of resources with higher rates of return, as a consequence.

In this sense, it has been said that one of the advantages of this reform, is that it spurs financial market development, by creating a demand for new financial instruments and institutions.

In the case of Mexico, this structural reform took place in 1997.[4] The new system replaced the old one by a defined contribution scheme. In the new system, workers are free to choose pension fund management companies, known as AFOREs, to administer their accounts. Up to 2004, there were almost 34 million accounts AFOREs. The retirement savings have evolved from 191 billion pesos in 1998 (4% of GDP) to 804 billion pesos in 2004, which represents almost 11% of GDP.

In this paper we analyse the implications for the Mexican financial system of substituting the PAYG pension system by a private FF scheme. With that aim, we begin by applying the Standard ADF test, in order to test each variable for the presence of a unit root relation. This test are required to validate the use of the cointegration technique of the Engle-Granger two-steps cointegration methodology, which has the advantage of distinguish a long-term OLS regression and an Error Correction Model for the short-term dynamics.

The rest of the paper is structured as follows: Part 2 contains a brief description of PAYG and FF schemes and the pension reform features. Part 3 Reviews the pension reform features for the Mexican case. Part 4 presents an econometric estimation of the macroeconomic effects of the switch, part 5 concludes.

2 The systems and the reform

2.1 The systems

2.1.1 Economics of the systems

Samuelson's (1958) two-period Overlapping Generations Model (OLG) is the precursor of the literature on social security. In this model, people are assumed to work in year *t* and retire in year *t+1* and for simplicity, the model abstracts from capital accumulation.

[4] A first attempt of a structural reform was held in 1992, creating the Retirement Savings System as a complementary scheme to the existing PAYG system. The attempt however, had some limitations which will be commented later in this paper.

A simplified version of the social security modelling in a two periods OGM is as follows:

In this economy, individuals are assumed to born at time t and consume c_{1t} when young and c_{2t+1} at time t+1. The lifetime utility for an individual is:

$$U(c_{1t}, c_{2,t+1}) = u_{c1t} + \frac{1}{1+\rho} u_{c2t+1} \text{ with } u' > 0 \text{ and } u'' < 0$$

There is a wage rate w_t that individuals get when young. It is assumed that there are no bequests in the economy, so that only the young individuals save at period t, this saving generate a capital stock in $t+1$ that is used with the young persons wage at $t+1$ to produce output.

In this economy, N_t are the individuals born at time t, and the population grows at a rate n, so that the number of young people at time t is $N_t = N_0(1+n)^t$.

With these elements, the problem for the individual is:

$$\max_{c1t, c2t+1} U(c_{1t}, c_{2,t+1})$$
$$\text{s.t.} \quad c1_t + s_t = w_t$$
$$c2_{t+1} = (1 + r_{t+1}) s_t$$

Where r_{t+1} is the interest rate paid on saving from period t to period $t+1$.

This implies FOC of the form:

$$u'(c1_t) - \frac{1+r_{t+1}}{1+\rho} u'(c2_{t+1}) = 0$$

Substituting with the savings and wages implies:

$$u'(w_t - s_t) = \frac{1+r_{t+1}}{1+\rho} u'((1+r_{t+1}) s_t)$$

An increase in the wage rate increases consumption in both periods. Assuming that the substitution effect dominates an increase in interest rates make people save more since the opportunity cost of current consumption is higher.

With social security, individuals pay a contribution d_t when young and receive a pension or benefit of b_{t+1} when old.

Under a PAYG program, the contributions of the young in period t are transferred directly to the current old at time t:

$$b_t = d_t(1+n) d_{t-1}$$

Under this scheme, the implicit steady state return on social security contributions is the rate of population growth, n. It can be said that 1+n young are needed to sustain the benefits of one old[5].

In a fully funded system on the other hand, the contributions of the young are invested and returned with interest next period.

$$b_t = (1 + r_t) d_{t-1}$$

The return on social security contributions is r_t .

In the PAYG context, a decline in n_t (due to a decline in fertility rate or a reduction in mortality, such that ageing increase) reduces the benefits received by the old. Therefore, if social security benefits (b_t) are to remain the same as before, contributions (d_t) must increase.

In other words, the Samuelson's OLG model showed that a PAYG scheme without capital and technical progress generates an implicit rate of return on each generation taxes', which equals the rate of growth of population. This happens because the number of taxpayers is larger than the number of retirees by the rate of growth of population.

In this context, PAYG schemes, as Samuelson noted, could raise welfare in an economy that has no capital assets. However, in an economy with capital assets, the reduction in the rate of saving caused by the provision of PAYG annuities can cause a reduction in the present value of all current and future consumption.

Only in the situation where PAYG scheme is mature, population growth is constant and PAYG is financially balanced, are pensioners paid, on average, a real rate of return equal to real wage of return in the economy. However, this two differ under a PAYG systems not only because the growth rate of the wage bill is typically lower than the real return on capital, but also because of the recent trend observed in *g* (growth of wages) and *n* (population rate) for most economies

2.1.2 PAYG features

A PAYG scheme is a contract of mandatory transfers from workers to pensioners. These transfers are backed by an implicit debt or a promise to contribution workers cohorts that they will benefit from future worker contributions once they retire.

In this kind of scheme, contributions made by today's workers, are used to pay the pension of the retired, so that what current pensioners receive is the funds paid by current workers in the form of payroll tax, rather than the

[5] If we introduce wages explicitly, the implicit rate of return is $(1+n)(1+g)$ where g is the wage increase rate.

revenues collected by the government from pensioners when they were working.

The main advantage of PAYG over FF systems is the inflation risk they are able to cover, as they are financed by taxing current working population while the funded schemes use accumulated assets to pay out pensioners. In this sense, only the State can guarantee indexed amounts of pension.

On the other hand, PAYG introduces several market distortions, mainly in the labour market, which leads to reductions in both output and welfare levels. These distortions are basically in two areas: labour force participation and the composition of formal and informal employment and unemployment.

Regarding the former, it can be said that under PAYG, working population is taxed to pay current retirees, and this induces workers to retire earlier, or reduce hours worked. Early retirement increases the annual cost of social security benefits and reduces the available labour income tax base, which implies higher marginal rate of social security tax and increases the source of deadweight loss. In this sense it is fair to say that the PAYG distorts not only the number of hours worked but also occupational choice, effort and location.
The, PAYG system also imposes an implicit tax wedge between the cost of labour to firms and the sum of the wage and the expected future pension benefits by the worker. The size of implicit PAYG tax on labour grows with the difference between the market interest rate and the expected rate of return of PAYG.

With respect to the composition of employment, under PAYG, employers are more likely to substitute capital for labour, giving rise to increase in unemployment rate or switching production to labour intensive countries. PAYG systems tend to raise gross labour costs in formal markets, thus expanding the informal sector, while depressing real net wages (this distortion is avoided by a FF). Unfortunately the informal sector suffers of at least two maladies, namely lower productivity and higher probability of pension's contribution evasion.[6].

In Latin America countries, the decrease in benefits paid under a PAYG system involves more than pure economic reasons. These countries allowed different pension schemes for different production sectors and group of workers. Moreover, the high macroeconomic instability resulted in frequent adjustments of contributions and benefits, by governments for fiscal purposes; while high and unstable inflation lead to major changes so that evasion of pension contributions leads to low coverage[7].

[6] Schmidt-Hebbel (1997) found that workers in Chile move from the informal to formal sector in response to the regime swithcing i.e. labour supply in formal sector remains at a lower level under PAYG schemes.

[7] Some other problems in the case of Latin America countries involve the rising deficits spilling into fiscal balances or leading to increasing payroll taxes as well as labour market distortions and informalization. Lack of efficient management of old pension systems lead to perverse redistribution toward powerful interest groups while old age poor were insufficiently protected. An additional problem of Latin American economies was their underdeveloped capital markets.

In this sense, Latin America pension reform is part of a development strategy based on decentralization of economic decisions to private agents. The Latin America countries that have successfully implemented a reform in their pension systems are: Chile (1981), Peru (1993), Argentina and Colombia (1994), Uruguay (1996), Bolivia and Mexico (1997), El Salvador (1998), Costa Rica (2001) and Dominican Republic (2003).

2.1.3 FF features

FF system is based on contributions to individual accounts in pension funds that are invested in financial markets and managed by pension-fund management companies (PFMCs) during workers active life and by insurance companies (ICs) during retirement.

In contrast to PAYG schemes, a FF scheme forces workers to save part of their working age income for retirement age. For the design of the scheme, the average return depends on market interests and rates of return.

With a FF system, inter-generational transfer is eliminated and people receive what they contributed, plus accumulated profits; the linkage between contributions and benefits is strengthened while the increase in payroll taxes and decrease in replacement rate are avoided. These features of the FF systems are the reason why it has been said that funded systems are beneficial to the development of capital markets[8].

Another advantage of a FF scheme is that savings are collected in Personal Retirement Accounts (PRA) so that there is little way to give the politicians the opportunity to redistribute funds toward favoured groups. These accounts are privately managed to avoid political corruption. To achieve a higher real rate of return, funds are completely managed by asset managers following maximization principles. In this sense, funding pension reforms can have a positive impact on financial market development as the function of financial markets is improved.

The levels of the contributions to the FF scheme are mandatory and in some countries, limited tax incentives to additional voluntary contributions are implemented. It is often argued that participation in a pension scheme has to be mandatory because people are short-sighted to provide for their own retirement. This has been known as the “myopia reason”, it is argued that in the absence of mandatory participation, some individuals would make no provisions for their own retirement, as they might believe that the government would not allow them to live in poverty when old, so that they save little, if anything, when young[9]. In other words, if contributors perceive that they are

[8] In a Latin America case, there is evidence linking Chile’s 23-year experience with growing financial system.

[9] Diamond (1977) found that in the absence of social security, a substantial fraction of the population would end up with insufficient amounts of wealth for their post-retirement period.

entitled to secure benefits when retired, they reduce discretionary saving accordingly.

In summary, there are two clear benefits of mandatory FF in comparison to mandatory PAYG: The former could make people more aware of the need to save for retirement (reducing the extent of myopia), the other is the contribution of FF to capital market deepening and removal of market imperfections.

2.1.4 Risks of both systems

It is important to note that while PAYG do not have asset price risk, they have the political risk that future governments cannot raise taxes when demographic or economic changes would make it necessary to do so in order to finance promised benefits. In other words, PAYG system is itself very risky in the sense that the level of future benefits depends on the willingness of future voters to support the taxes required giving such benefits. In summary, the political risk related to PAYG implies an excessive benefit promised to future retires.

On the other hand, the risk of a FF system is sometimes characterized as a problem of the riskiness of portfolio returns. As Feldstein (2005) has argued, this is a quite manageable problem in a prefunded system in which individuals invest in a broad index of stocks and bonds.

It can be said that pension reform reduces overall uncertainty by decreasing political risk, but raises it by reducing the insurance purpose of the pension system.

2.2 The reform

There are four main issues related with pension reform: the transition, the effects on financial markets, the distributional effects of the shift and the requirements and regulations for the new scheme. In the next sub-section, a brief description of these issues is presented.

2.2.1 The transition

Two basic features differentiate the evolution of the reform during the transition period: the nature of this transition and the way the transition is financed.

There are two alternatives for the transition to be implemented: Immediate transition with “recognition bonds” or gradual transition. With the former, social security system is eliminated and employees are required to save in mandatory saving accounts (FF system). With the latter, (during a possibly

long period), future retirees would receive a mixture of PAYG benefits and benefits based on the assets of FF Personal Retirement Accounts (PRAs).

With respect to the financing of the transition, PAYG is by definition unfunded, and this implies that governments must consider the budgetary deficit or implicit debt once pension benefits cannot be covered by the accumulated payroll taxes collected.

There are reform transition deficits caused by the shortfall of pre-reform PAYG pension contributions that are now invested in FF whilst government continues its PAYG commitments by paying current and future pension benefits to those contributors that remain affiliated with PAYG.

In this sense, there are two fundamental ways how transition deficits can be financed: The implicit PAYG debt can be swapped for other public sector asset resources, for example by selling government assets (or using international reserves) or by issuing more debt. It can also cut expenditure or raise taxes for a period that lasts as long as transition deficit lasts, (contractionary fiscal policy).

The transition implies transfers towards future generations when part of the transition deficit is financed by taxation. In the case of a tax-financed transition, the welfare effects are ambiguous. On the one hand, the transition raises Pareto efficiency by eliminating the pure-tax component of PAYG contributions. But on the other hand it reduces Pareto-efficiency by increasing general taxation needed to pay for a tax-financed transition of the interest payments on the higher explicit government, debt.

However, it is more likely that the reform brings Pareto welfare gains from the elimination of distortions and dead weight losses in capital and labour markets. Even if tax revenue is used for the transition, the initial deficit would not decrease national saving because of the increase in private saving.

The most straightforward way to finance the reform is by issuing new government debt. In this case, the old implicit PAYG debt is swapped for new explicit government debt, and the government is required to generate additional government revenue, to the extent that interest rate increases when FF substitutes explicit new debt for implicit PAYG debt.

2.2.2 Effect on financial markets

The substitution from a PAYG to a FF system can affect growth through the financial market. At least in theory there is a positive relation between financial development and economic growth. This effect is transmitted through two channels: increased savings and more efficient allocation of this savings. In this sense, a greater proportion of long-term capital assets are related to larger time horizon thus reducing the term and the equity risk premium. This shift to long-term assets is related to a reduction in the cost and an increase in the availability of equity, promoting an increase in productive capital formation.

On the other hand, pension system reform has an important indirect effect on economic growth brought about by accelerating the process of financial development. The indirect effects of a funded system include: the promotion of qualitative developments on financial markets, i.e. financial innovation and modernization of financial infrastructures. This changes are likely to promote competition in the banking sector, and thus creates room for a dynamic legal framework, which improves market transparency.

We can also point that an additional consequence of the pension fund reform on capital market development is that, due to the overall development on the capital market, the direct costs of issuing securities are likely to be lower and this implies a reduction in the cost of capital. From a theoretical point of view, more liquid stock markets increase incentives to invest in long-duration projects, so that good investment projects with long duration can be undertaken encouraging economic growth.

Finally, it is accepted that macroeconomic stability is necessary for the reform of the pension system to have any positive effect in the economy. On the other hand it is also true that the reform itself can contribute to macroeconomic stability not only by reducing interest rate volatility, but also by alleviating the political and demographic pressures of the previous system.

2.2.3 Distributional effects of the shift

The transition from a PAYG to FF system requires replacing the distributive function implicit in the PAYG system. The main distributive element available to the government is the guarantee of a minimum pension to all the contributors to the system.

In some cases of fully-funded schemes, there is a mandatory, publicly managed and tax-financed distributive pillar, where people receive universally the same benefit when retire, usually a minimum pension guarantee.

In a PAYG scheme, the government can raise current workers contributions when current contribution levels are insufficient to finance minimum-pension benefits.

In contrast, in a FF scheme, the government must rely on general tax revenue in order to pay for this program, as otherwise, the minimum pension would depend on the riskiness of the assets in which pension funds are invested.

2.2.4 Requirements and regulations

For the new system to perform efficiently, strong and effective government regulation is required.

A private social security system comprises workers (required to save funds for retirement), pensioners, and two groups of private providers (pension fund management companies PFMCs and insurance companies).

In this sense, international diversification of pension fund portfolios is desirable because it allows pensioners to improve their portfolio risks and returns. Investing abroad precludes pension funds from acquiring excessive market power in local capital markets.

For instance, in Latin America, PFMCs and ICs are subject to regulations on minimum capital requirements and reserves. PFMCs supervision is performed by specialized PFMC institutions. Investment of reserves of pension annuities by life insurance companies are subject to portfolio regulations.

3 The Mexican case

3.1 The old system

Mexico's public pension system was established in 1944 with the objective of providing coverage to private sector workers[10]. This pension system was a PAYG scheme managed by the Mexican Social Security Institute (IMSS) and thus suffered from all the problems described in the previous section. Even so it is important to consider the problems that affected the Mexican public pension system, and ultimately made the reform unavoidable. In the end the reasons behind the reform was the combination of a not completely adequate designed pension program with a the demographic trend

The problem with the public pension system design was that it promised to pay high benefits. Under the original system a worker was eligible to receive benefits after just 500 weeks of contribution (about 10 years), but this benefits were not very sensitive to the additional years of contribution[11]. As such, once the worker satisfied the minimum contribution period, the incentives to keep working vanished, thus creating important distortions in the labour market. In other words, once the minimum contribution time was satisfied, the worker had no incentives to continue contributing, as he was guaranteed a minimum pension equivalent to the minimum wage (indexed to the consumer price index since 1989). In addition to this problem, the system extended the medical assistance coverage to the worker's relatives

The immediate consequence of this system was the raise of the informal sector. The minimum salary at the time of the reform was only 60% of what the World Bank considers for "adequate" living standards. In this sense, once the minimum requirement was reached, many workers decided to drop out to the informal sector.

Another problem with the design of the system was that its benefits were based on the average base wage of the last five years of contribution to the system divided by the minimum wage at the time of retirement. This situation created the incentive to retire earlier than the worker normally would if his salary was likely to decrease.

Finally there was the issue of tax evasion. The old system was basically funded by means of payroll taxes with the the employer, the employee and the government, contributing 70-25-5 percent respectively. As such the

[10] Public sector workers have their own pension and health care systems (ISSSTE) and a special fund for the workers of the petroleum company (PEMEX) among others (military and police forces). These systems are not part of the reform although all of them are have a PAYG basis. This reform is one of the "time bombs" of the Mexican economy.

[11] For instance, regardless of the number of years a person who earned one minimum wage contributed to the system, he would receive the same pension when retiree. Another example is a person who earned ten times the minimum salary, and contributed for ten years to the system, would get 14% of his wage replaced and 16% after thirty years of contribution.

employers had an incentive to understate the wage rate of their workers to avoid paying the payroll tax.

With respect to the demographic trend, the point can be best illustrated with some statistical figures. The fertility rate decreased from 6.45 children per woman in 1950 to 2.84 in 1995 and is expected to be 1.85 by 2027. At the same time, the mortality rate of people in old age has fallen. Life expectancy at birth has risen from 46.6 years on 1950 to 72.6 years in 1995 and is expected to be 81.3 years by the year 2050. An immediate consequence of this trend is the reduction in the number of workers per retiree. In 1950, the system had 67 workers per retiree, by 1994 there were only 8 workers per retiree and by the year 2050 it is estimated that there will be 2. In 1995, the IMSS projected that the rate of growth of retirees for the next 20 years of 5.7%, while the rate of growth of the contributors was expected to be 2.6%, thus furthering the coverage strain.

The situation presented here lead to an increase in financial problems faced by the government to sustain the pension scheme. In fact Government estimates, show that the payroll taxes on the base salary, would have to rise in 2020 to nearly 24%, from the actual 8.5%, in order to sustain this system. Estimates also show that in 1992 the the imbalance of the pension system was about 80% of GDP.

Finally, it is worth noting that the lack of transparency was a problem of the old system almost since the beginning. Resources of the system were used to finance infrastructure requirements and health expenditures.

3.2 The new system

3.2.1 First attempt for a new system

The first attempt to reform the old pension system was done in 1992 and was known as the “Retirement Savings System” or SAR[12]. The system had a fully-funded basis with individualized retirement accounts and covered for both private and public sector workers. The SAR-92 was designed to complement the existing PAYG system with a compulsory employer contribution of 2% of total payroll.

However, this attempt was far from being sufficient. Part of the problem was because Mexico did not have a national identification number for each worker when the SAR-92 was made[13].

In addition there was no entity responsible for supervising the funds. The funds of the retirement sub-account were used by the government as a direct loan, who paid a direct interest rate of no less than 2% per year over the real balance. With the purpose of supervising this first system, the National

[12] SAR stands for Sistema de Ahorro para el Retiro in Spanish.
[13] An example of the logistic problem that the SAR-92 implied, for a universe of 10 million contributors to the system, the SAR-92 created more than 40 million accounts.

Comission for the Savings for Retirement System (CONSAR) was created in 1994[14].

All these problems created the need of a structural reform to replace (not complement) the old system. In particular, a clear property rights definition over the workers accounts was needed.

3.2.2 The structural reform

In December 1995, the Congress approved the new social security law (Ley del Seguro Social). A second set of laws containing the retirement savings system law were approved in 1996 (Ley de los Sistemas de Ahorro para el Reiro). The new system began to operate on July 1, 1997. This reform has been considered the Ernesto Zedillo's administration most important reform.

The new pension system consists on a fully funded system with defined contributions. The system is mandatory for all the private sector workers and the funds are administrated by specialized private companies (AFORE)[15]. The AFOREs manage the individual retirement funds known as SIEFOREs[16]. The AFOREs charge commissions for their services and the CONSAR is the specialized government agency that supervises the industry. Workers are allowed to choose the AFORE they want for their funds to be managed, two changes per year are allowed (without financial penalty) as soon as the chosen AFORE is cheaper in terms of commissions charged.

In beginning, each AFORE was allowed to manage only one SIEFORE, and the number of AFORESs supervised by CONSAR was around 15. By August 1994, there were 13 AFOREs and 32 SIEFOREs.

Similar to the old system, contributions are made by employers, employees and government. Each month, the worker deposits a compulsory rate of 6.5% of his wage on his individual retirement account. The government adds to each worker account a "social contribution" of 5.5% of the minimum wage as of January 1997. In addition, the employer has to pay an additional 5% to a housing sub account. The design of the system states that this sub account will be consolidated with the AFORE account upon worker retirement. An additional 4% of the wage has to be paid to a disability and survivors account managed by the IMSS. Additional voluntary contributions are allowed[17].

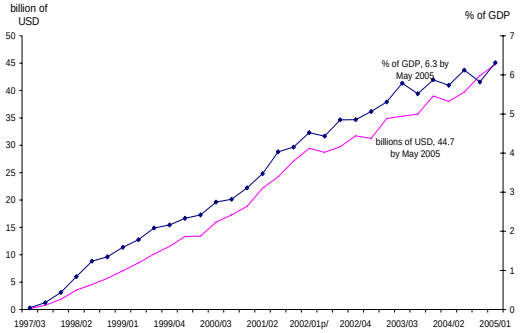
[14] CONSAR stands for Comisión Nacional de los Sistemas de Ahorro para el Retiro.
[15] AFORE stands for Administradora de Fondos para el Retiro, which are the pension funds management companies.
[16] SIEFORE stands for Sociedades de Inversión Especializada en Fondos para el Reitro.
[17] A more detailed description of the composition of the funds is as follows: each individual account has four sub-accounts. 1. The "Retirement, severance at old age and old age" (Retiro, cesantía en edad avanzada y vejez) sub-account; contributions made by employers, employees and government are deposited here. 2. The voluntary contributions sub-account; without minimum or maximum limits, either the employer or the employee can make voluntary contributions in this sub-account. 3. Housing sub-account; employer contributions equivalent to 5% of wage. 4. Complementary contributions sub-account; either the employer or the

In contrast, the new system defines 1250 weeks (around 25 years) as the minimum contribution time required until retirement. The government, on the other hand, guarantees a pension equivalent to a minimum wage. Upon retirement, the worker has two options: the first is to use the money accumulated in his individual account to purchase a lifetime annuity from a private insurance company. The second option is to leave the savings in his individual account and make programmed withdrawals based on his life expectancy. If the worker has accumulated enough funds to purchase an annuity at least 30% higher than the minimum pension, he can opt for an early retirement, but in this case the worker does not qualify for the guaranteed minimum pension.

In terms of the number of affiliated accounts, Mexico pension system ranks the first in Latin America, with almost 34 million accounts[18]. In terms of assets under management, by July 1998 investment in the system was equivalent to 4.4 USD billion, by May 2005; the investment is around 47.32 USD billions.

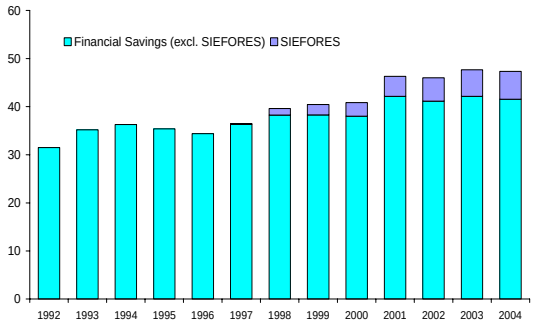
In this sense, the reform of the Mexican's pension system as played an important part in the increase of long-term domestic financial savings. Statistics show that they have risen to 47.3% by the end of 2004 from 31.5% of GDP by the end of 1992, while pension fund assets represented around 6% of GDP[19].

SIEFORES funds



Source: Bank of Mexico
Figures as December of each year.

Financial Savings as % of GDP



Source: Bank of Mexico
Figures as December of each year.

Regarding the portfolio composition of SIEFORES, funds are still highly concentrated in government bonds. By May 2005, 85% of assets under management were invested in Government Bonds; however the share of corporate bonds is rapidly increasing, and represent around 13% of the invested assets. It is worth noticing that a more flexible investment regime has been approved by the CONSAR. The most important changes imply the possibility of investment in local and international equities up to 20% of their

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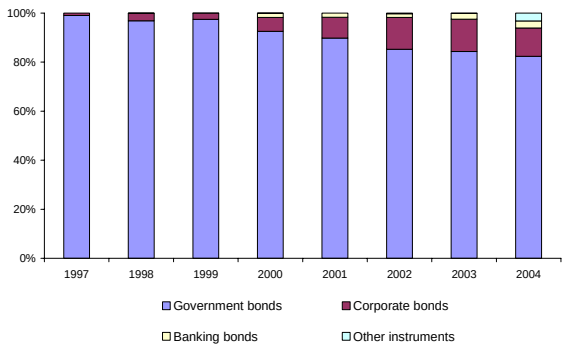
employee can make contributions; this resources are only available at the moment of retirement.

[18] This number does not mean that there are 34 million people in the system, as each worker may have more than one account,

[19] An illustrative set of graphs can be found in the Appendix 2.

total portfolio[20]. CONSAR specify the investment grade for the private debt to be eligible, in this sense, a BBB rate requirement exists since 1991.

Investment of the SIEFORES[1_/]



Source: Bank of Mexico
Figures as December of each year.

Some other requirements imposed by CONSAR involve the maintenance of a minimum capital requirement for each AFORE. Each AFORE is required to maintain an investment reserve which is a percentage of the total assets under their management. There is a formal market share limit of 20% of each AFORE. However, in the case that an AFORE goes bankrupt, Government protect worker's savings.

3.2.3 The transition

Three groups of workers are relevant in any pension reform process: the already retired workers, the transition workers and new workers. The first group in the Mexican pension reform represented around 1.6 million workers, and their benefits are guaranteed.

The transition workers are those workers already in the labour force by December 31, 1996. In the case of Mexican reform there was no option for the transition workers to remain in the old system and no "recognition bonds" were available. All transition workers were encouraged to choose an AFORE and transfer to the new system by 2001[21]. However, a "life-switch" option was available, which implied that when the worker reaches the retirement requirements, he can choose the system with the highest level of benefits[22].

[20] Permitted debt securities must be issued by Governments, Central Banks and governmental agencies of countries members of the Technical Committee of the IOSCO or the European Union, Corporations, as long as the securities are issued in a market under the regulation of any country member of the Technical Committee of the IOSCO or the European Union, and Multilateral financial entibies (i.e. IDB or The World Bank, etc).

[21] The resources of workers who have not transferred to an AFORE were deposited in a special account at Bank of Mexico and the Government assigned an AFORE for them.

[22] In the case the worker chooses the old system, he will receive his full IMSS benefit plus accumulated SAR balances only up to December 1996 plus returns.

The “life-switch” option has been criticized as it can create a moral hazard problem: riskier investment strategies can be can be pursued by workers as they can always fall back to the benefits of the precious system.

All the new workers (those who join the labour force since 1997), are automatically in the new system and have to choose an AFORE.

4 Empirical analysis

In this section we analyse the implications for economic growth and financial markets of the movement from a PAYG to a fully funded pension system. With that in mind we begin by presenting some previous empirical evidence of the impact of pension fund assets on economic growth. We then proceed to describe the methodology and the data used, and to end this section we present several estimation results.

4.1 Previous empirical analysis

In the next sub-section, results of previous empirical analysis related to the direct and indirect effect of the reform on economic growth are presented. This section does not pretend to be an exhaustive account of the existing empirical literature; but pretends to explore some of the most recent and better documented works on the empirical analysis.

4.1.1 Financial development and economic growth

King and Levine (1993) estimate a cross-country regression for 80 countries over a period of 39 years and found evidence that is consistent with Schumpeter’s view that the financial system can promote economic growth[23]. Their study consists on analysing the empirical relationship between four financial indicators and four growth indicators.

The four financial indicators are the ratio of the size of the formal financial intermediary sector to GDP, the importance of banks relative to the central bank, the percentage of credit allocated to private firms and the ratio of credit issued to private firms as a percentage of GDP.

On the other hand, the measures of economic activity include: the rate of physical capital accumulation measured as an estimate of the per-capita growth rate, and improvements in the efficiency with which economies employ physical capital. In addition of the previous variables, King and Levine included the ratio of trade (exports and imports) to GDP, the ratio of

[23] The authors conduct two analyses: a pure cross-country analysis using data averaged over the 1960-1989 period and a pooled cross country time series study using data averaged over the 1960s, 1970s and 1980s.

government spending to GDP and the average inflation rate to control for other phenomena.

For the sample of countries being considered, they conclude that measures of financial development are associated with the measures of economic activity. In particular, they find that higher levels of financial development are positively associated with faster rates of economic growth, physical capital accumulation and economic efficiency improvements. In addition, they show that there is a positive relationship between the level of financial development and future rates of long-run growth of physical capital accumulation and economic efficiency improvements.

For the case of Chile, Holzman (1997) showed econometrically that the development of financial markets in Chile correlates with strong development of the real side of the economy via rising TFP and capital accumulation. His estimations imply that long term growth in Chile is 1-3% higher owing to the effects of the pension reform operating via financial markets.

Beck, Levine and Loayza (2000) study the relation between financial intermediation and the sources of economic growth. Among the sources of growth the authors analyse the following: private saving rates, capital accumulation, TFP growth and overall real per-capita productivity growth. The primary measure of financial intermediary development they employ is private credit. In order to asses the robustness of their results, Beck, Levine and Loayza use two additional measures of financial development: liquid liabilities as percentage of GDP and commercial bank domestic assets divided by commercial bank plus central bank domestic assets. An interesting variable that the authors include is the legal origin of each country in their sample, where they include a dummy variable for British, French, German and Scandinavian legal origin. They think the thesis that cross-country differences in legal origin help explain differences in financial development.

They find evidence that financial intermediaries exert a positive impact on total factor productivity growth and real per capita GDP growth. However, the evidence of a long run relationships between financial intermediary development and both physical capital growth and private savings rates is weaker.

4.1.2 Pension fund assets and financial development

Walker and Lefort (2000) use a panel data approach to analyse a sample of 33 emerging economies and a sub sample of 7 Latin American countries. They argue that one of the most important effects of the pension system reform on economic activity is the improvement in the allocation of funds for investment proposes, which should translate into a better resource allocation. This better allocation of resources could have permanent positive effects on growth and welfare as long as investment in private securities is allowed.

They test the hypothesis that pension fund reform reduces firm cost of capital and stock market volatility. As a proxy of the firms cost of capital they use dividend yields and price to book ratios, and the per capital income as a general measure of the development of the country, the annual inflation rate and the assets of deposit money banks to GDP as a measure of the development of capital markets. The authors use total assets of pension funds, a measure of the investment in stock by pension funds and the relative importance of investment in stock and private bonds on the total market. The empirical evidence is in the sense that pension fund investment in stocks is associated with required responsiveness to external shocks and also price-to book ratios tend to be positively associated with it.

Specifically, the evidence for Chile shows several direct and indirect effects that the reform has had on the creation (or implementation) of new financial instruments. They also find evidence in the sense that transition costs tend to decrease as a side effect of the pension system reform and asset accumulation. Pension fund importance decreases the average dividend yield and increases private to book ratios of firms. They find evidence that dividend yields are lower after the reform, and in the case of Chile, transaction costs decreased as a side effect of the pension reform and asset accumulation.

Granville and Mallick (2002) investigate the link between capital markets reform and savings, with particular focus on the case of the pension system reform in the UK with annual data form 1978 to 2000. With this aim in mind the authors implement an analysis with the following variables: aggregate savings rate, credit to the private sector as a percentage of GDP to indicate the liquidity constraint on households, ratio of the net investment by private pension funds over the working-age population, real interest rate, real expenditure on public pension benefits divided by the population over 60 years, the dependency ratio, government fiscal balance and per capita growth.

They find that higher pension assets are associated with a net increase in national savings. However, as the authors note, the results should be treated with caution because the relatively short sample size.

Corbo and Schmidt-Hebbel (2003) measure the effect of Chilean pension system reform on financial development from 1960 to 2001. In order to measure this development, the authors consider a variable called financial intermediation ratio which represents the main financial assets in the economy as % of GDP; as explanatory variables they consider a financial liberalization index, pension fund assets, a dummy variable for critical levels of inflation, interest rate, inflation rate and a measure of the deviation of the real exchange rate with respect of its tendency.

The authors find a long run relationship between financial development and control variables and pension fund variables.

Davis and Hu (2004) investigate the direct link between pension assets and economic growth, using a variety of methods. In particular, their analysis

considers the following variables: output per worker, pension fund assets as percentage of GDP, capital per worker and they study a set of countries.

They find that pension assets as percentage of GDP is positively and significantly affect output in a variety of economic specifications, and with a larger effect for EMEs than OECD countries. Their results imply that pension assets growth boost both capital and output during the initial few years before following a gradual decline.

Hu (2005) uses a dataset covering 59 countries, including both OCED countries as well as emerging market economies. Hu examines a variety of estimations considering both the effect of pension reform and economic growth as well as the indirect effect through the financial development[24].

He finds a positive and statistically significant link between pension fund and economic growth, in the long run and a negative relationship in the short run. The economic growth variables considered are total factor productivity growth rate, gross physical capital formation as a percentage of GDP and private saving rate, gross domestic saving as percentage of GDP, and gross national saving as percentage of GDP. Hu also finds a strong positive link between pensions and the TFP growth rate, the gross fixed capital formation growth rate and GDP growth rate.

Finally, Hu analyzes the relationship between pension fund assets and financial development. He finds a positive short run effect from pensions to private credit provided by banks and other financial institutions, while the long run relationship is not significant. The author also finds econometric evidence in the sense that pension funds growth leads to less credit provided by commercial banks in the economy both in the short and in the long run.

By looking at the stock market, he finds a strong positive link between pension fund assets and three stock market indicators: market capitalization, market value traded and market turnover. In all three indicators, there is a strong effect both in the short run and in the long run.

In the next section we follow Hu (2005) and Corbo and Schmidt-Hebbel (2003) papers, to perform an econometric analysis of the Mexican pension system reform. We begin by analysing the presence of cointegrating relationships among variables, by using the Engle and Granger two steps methodology. The next section presents a brief description of this methodology.

4.2 Engle and Granger two steps methodology.

In this procedure, given a set of non-stationary variables, the existence of a common trend is tested. The two steps are as follows:

[24]The variables used in the present analysis were chosen basically following Hu (2005)

Step 1: Begin by Regressing one variable against the other(s) of the same order to obtain an estimate of the cointegrating vector. If the variables are cointegrated, OLS estimators provide consistent coefficients[25].

$$y_t = \beta_0 + \beta_1 x_t \qquad (1)$$

Step 2: There are two possibilities to analyse the presence of cointegration relationship between the variables, i) test for cointegration on the residuals of (1) or ii) test for significance on the Error Correction Model (ECM).

The first possibility is known as the residuals-based approach. It consist on testing the residual $z_t = y_t - \beta_0 - \beta_1 x_t$ for stationarity and if z_t is stationary, conclude in favour of cointegration. The test $z_t = \rho z_{t-1} + \upsilon_t$ with υ_t white noise is equivalent to $\Delta z_t = a_1 z_{t-1} + \varepsilon_t$ with the null hypothesis $H_0 : a_1 = 0$..

When testing for a unit root under the residuals-based approach, the following possibilities arise:

Table1

Relation between variables

y_t	x_t	e_t	
I(0)	I(0)		Both series are stationary. The classical regression model is appropriate.
I(d)	I(b)		Id d ≠ b, the estimation is meaningless.
I(d)	I(d)	S	This is the case of spurious regression. A model with both variables in first differences is appropriate.
I(d)	I(d)	NS	y_t and x_t are cointegrated, there are an ECM that counts for the adjustment to the long-run.

S = stationary, NS = non-stationary

It has to be noted that since $\hat{z}_t$ is generated from a regression equation, the true values of z_t are unknown and the distribution of the test statistic under Ho ($a_1 = 0$) is affected by the number of regressors included in (1). There are special critical values for this test. (McKinnon, 1991).

If the variables are cointegrated, they have associated the following Error Correction Model (ECM)[26]:

$$\Delta y_t = \alpha_1 + \alpha_y (\hat{e}_{t-1}) + \sum_{i-1} \alpha_{11(i)} \Delta y_{t-i} + \sum_{i-1} \alpha_{12(i)} \Delta z_{t-i} + \varepsilon_{yt} \qquad (2)$$

[25] The generated estimators are consistent in the sense that as T→∞, the estimation of $\hat{\beta}$ converges to the "real" β and any deviation in finite samples converges to 0 as T→∞. Stock (1987) showed that these estimators converge master than the same estimators if both series were be *I(0)*.

[26] Granger's representation theorem.

From this estimation, the significance level of the EC Element (et-1) has to be tested. If it is statistically significant, conclude in favour of cointegration. [27]

It is worth noting that as in the econometric estimations that evidence of no cointegration was found, although the appropriate strategy would be to employ specifications in first differences, these models are not presented here as these models have no long-run equilibrium solution.

For the estimations we use the general-to-specific approach proposed by Hendry. This approach consists of starting with a broad model that is reduced as the coefficients are insignificant in a successive bias, thus ensuring the model specification follows the parsimony principle.

[27] The ECM with two variables has associated the following model as well: $\Delta z_t = \alpha_2 + \alpha_z(\hat{e}_{t-1}) + \sum_{i-1} \alpha_{21(i)} \Delta y_{t-i} + \sum_{i-1} \alpha_{22(i)} \Delta z_{t-i} + \varepsilon_{zt}$ If α_y and α_z are both statistically different from zero, a VAR is estimated. In the present empirical work, this was not the case, so that only (2) was estimated.

4.3 Estimation results.

4.3.1 The Data

The next table contains the variables used for the empirical analysis. The set of graphs used for the estimations and the source of each variable can be consulted in the Appendix A.

Table 2

Description of the variables

AFI	M3a = M2a + financial assets held by non-residents - currency outside banks.
PFAR*_/	Pension fund assets.
FINLIB	Financial liberalization (number of financial law reforms in each year)
CT28	Short term Mexican interest rate
3MTB	3-Month treasury bill
PPCCPR	Short run private real interest rate
INF	Inflation Rate
GPRER	Real exchange rate gap, constructed as the difference of RER and a Holdrick-Prescot filtered RER
OPEN	Openness defined as exports plus imports as % of GDP
IVPFI	Production index
PFAGDP	Pension fund assets as % of GDP
BYMGDP	Currency in circulation as % of GDP
FBCGDP	Domestic financing by commercial banks as % of GDP
IPC	Mexican stock market index
TOR	Stock market turnover
GPGDP	Government expenditure as % of GDP
CIBRAFI	Deposits in resident banks as % of total financial savings
AFIGDP	Financial savings as % of GDP
VMVGDP	Stock market capitalization as % of GDP
OMBGDP	Stock market value traded as % of GDP
VPUPRAFI	Public securities held by residents as % of financial savings
VPRPRAFI	Private sector securities held by residents as % of financial savings
IGAE	Global Index of Economic Activity

*_/ It is worth noting that in the following sections, pension fund assets comprises only privatized pension fund assets (IMSS assets), excluding non-reformed pension fund assets.

Additionally, three dummy variables were considered:

DINF is a dummy variable that accounts for outstanding values for inflation rate. This variable takes values of 1 for annual inflation rates above one standard deviation from the mean of the period[28]. DPEN is a dummy variable that takes values of 1 after the implementation of the new pension system reform in 1997. Finally, D04 when the financial liberalization reform variable is not explicitly considered. This variable accounts for the important changes in the Siefores investment regime during 2004.

[28] Above and below the one standard deviation line on the inflation graph. This period covers from April 1996 to March 1997.

The first step for the estimation is to test the order of integration of the variables. From the ADF test, with trend and intercepts, it can be concluded that the only three variables that are stationary are PPCCPR, TOR and GPGDP. For all the other variables, the null hypothesis of existence of a unit root in the series can not be rejected.

The next table presents the results of unit root test obtained using the Augmented Dickey-Fuller test.

Table 3

Augmented Dickey-Fuller Test of Stationarity

	ADF in levels		ADF in first differences		
	Without intercept	With intercept	Without intercept	With intercept	~I( )
FIRR2	-0.992	1.084	-5.023	-4.805	I(1)
PFAR	-1.268	3.126	-5.207	-2.946	I(1)
FINLIB	-2.176	-2.027	-5.479	-5.477	I(1)
CT28	-2.873	-2.592	-8.076	-8.097	I(1)
3MTB	-2.094	-1.657	-3.63	-3.636	I(1)
PPCCPR	-4.563	-3.172	-6.703	-6.734	I(0)
INF	-2.530	-2.065	-3.643	-3.658	I(1)
GPRER	-3.488	-3.493	-6.951	-6.975	I(1)
OPEN	-1.573	-1.939	-6.522	-6.145	I(1)
IVPFI	-2.605	-0.884	-6.889	-6.92	I(1)
PFAGDP	-1.790	1.983	-8.124	-7.372	I(1)
BYMGDP	-0.679	0.302	-6.802	-6.683	I(1)
FBCGDP	-3.170	-0.488	-7.126	-6.017	I(1)
IPC	-0.711	1.414	-7.118	-6.778	I(1)
TOR	-5.297	-4.626	-8.989	-9.000	I(0)
GPGDP	-4.438	-1.497	-9.964	-9.993	I(0)
CIBRAFI	-2.003	0.41	-5.674	-5.295	I(1)
AFIGDP	-3.107	-0.479	-10.68	-10.715	I(1)
VMVGDP	-2.731	-2.162	-6.913	-6.802	I(1)
OMBGDP	-3.946	-3.237	-8.103	-8.118	I(1)
VPUPRAFI	-3.333	-0.52	-4.892	-4.166	I(1)
VPRPRAFI	-1.422	-1.461	-5.158	-5.163	I(1)
IGAE	-2.599	-0.282	-5.419	-5.424	I(1)

Note: ADF unit root test is based on four lags; critical values are: 1% = -4.012, 5% = -3.436 and 10% = -3.142.

4.3.2 The effect on economic indicator

Once the order of integration of the variables has been tested, the following general formulation was estimated:

$$DLIVFPI_t = \beta_0 + \sum_{i=1}^{4} \beta_{1i} DLIVFPI_{t-i} + \sum_{i=0}^{4} \beta_{2i} DLPFAGDP_{t-i} + \sum_{i=0}^{4} \beta_{3i} DLFBCGDP_{t-i} + \sum_{i=0}^{4} \beta_{4i} DLOPEN_{t-i} + \sum_{i=0}^{4} \beta_{5i} DLINF_{t-i} + \beta_6 ECM_{t-1}$$

$$ECM_{t-1} = \alpha_0 + \alpha_1 LIVFPI_{t-1} - \alpha_2 LPFAGDP_{t-1} - \alpha_3 LLFBCGDP_{t-1} - \alpha_4 LDOPEN_{t-1} - \alpha_5 DCRISIS_{t-1} - \alpha_6 DPEN_{t-1}$$

The result of the first step of the Engle – Granger methodology which is the estimation of the relation in levels is presented in the next table:

Table 3

Pension fund assets and economic indicator
Long run relation

	LIVFPI
C	4.577
	(32.397)
LPFAGDP	0.015
	(1.767)
LBYMGDP	0.116
	(2.102)
LFBCGDP	-0.079
	(-3.512)
LOPEN	0.217
	(7.111)
DCRISIS	-0.130
	(-8.965)
DPEN	0.040
	(2.479)
R2	0.927
Adj. R2	0.924
S.E. of reg.	0.036
DW stat.	0.879
F-statistic	309.822
Prob(F-statistic)	0.000

t-statistics in parenthesis

The residuals of this estimation were analyzed and the null hypothesis of the existence of a unit root was rejected favouring the alternative of no unit root, it can be said that the residuals are stationary[29].

[29] The unit root test on these and all the other residuals are available upon request.

The ECM explains around 71% of the production index variation. Durbin-Watson statistic shows that there are not first order autocorrelation in the residuals.

It can be seen that the coefficient of the Error Correction element is statistically significant and $-1<ECM<0$ as expected [30]. This element is a measure of the speed of adjustment that is 0.27 in this case. This means that in each period, the production index will adjust to its growth rate in an amount equivalent to at almost one third of deviation of the last period with respect to long-run level.

From this estimation, it is revealed that pension assets have been positively and significantly linked to growth. This is consistent with previous empirical literature results and is particularly consistent with Hu (2005) results in the sense that pension growth induces higher productivity in emerging markets. In the short run a detrimental effect of contemporaneous inflation can be seen. There is also evidence that higher interest rate dampens IVFPI. In terms of credit, there is a negative sign associated with the impact regressor that is compensated with positive effects in the next periods. The negative sign although intriguing was also found by Davis and Hu (2004) who argues that large banking lending might contribute to macro economic volatility, for example via commercial property cycles, consequently, economic growth is affected negatively. It is worth noting that although a variable of government expenditure was included in the short run estimation, it was not statistically significant.

4.3.3 The effect on financial development

The effect of pension fund assets on financial development can be analyzed trough four aspects, financial intermediaries, the banking industry, the stock market and the bond markets. Financial intermediaries are proxied by considering financial savings as percentage of GDP and financial savings in real terms as the dependent variable[31].

The general formulation of the following estimations is:

$$DLK_t = \beta_0 + \sum_{i=1}^{4} \beta_{1i} DLK_{t-i} + \sum_{i=0}^{4} \beta_{2i} DLPFAGDP_{t-i} + \sum_{i=0}^{4} \beta_{3i} DLIGAE_{t-i} + \sum_{i=0}^{4} \beta_{4i} DLIPC_{t-i} + \sum_{i=0}^{4} \beta_{5i} DLFBCGDP_{t-i} + \sum_{i=0}^{4} \beta_{6i} DLOPEN_{t-i} + \sum_{i=0}^{4} \beta_{7i} DLINF_{t-i} + + \sum_{i=0}^{4} \beta_{8i} DLCT28_{t-i} + \sum_{i=0}^{4} \beta_{9i} DLTOR_{t-i} + \beta_{10} ECM_{t-1}$$

[30] This condition is necessary for the model to be stable, the short run regressions of this and the other estimations can be consulted in the Appendix B.
[31] This second estimation was made based on Corbo-Schmidt Hebbel (2003) estimation.

$$ECM_{t-1} = \alpha_0 + \alpha_1 LK_{t-1} - \alpha_2 LPFAGDP_{t-1} - \alpha_3 LBYMGDP_{t-1} - \alpha_4 LBCGDP_{t-1} - \alpha_5 DLOPEN_{t-1} - \alpha_6 DCRISIS_{t-1} - \alpha_7 LIGAE_{t-1} - \alpha_8 LIPC_{t-1} - \alpha_9 LTOR_{t-1}$$

Where K is a vector of dependent variables including the following: *AFIGDP*, *FBCGDP, VMVGDP*, *VPUPRAFI* and *VPRPRAFI*. *ECM* is an error correction term which measures the speed of convergence from short to long run equilibrium.

Table 4
Pension fund assets and financial indicators
Long run relation

	LAFIGDP	LFBCGDP	LVMVGDP	LVPUPRAFI	LVPRPRAFI
C	4.244	11.193	2.965	9.185	0.162
	(10.989)	(9.390)	(3.309)	(19.341)	(0.518)
LPFAGDP	0.177	-0.206	-0.454	0.122	-0.215
	(16.837)	(-5.317)	(-15.491)	(4.204)	(-11.601)
LBYMGDP				-1.259	1.794
				(-6.639)	(14.810)
LFBCGDP				-1.473	-0.167
				(-19.272)	(-2.753)
LOPEN				-0.282	
				(-3.044)	
DCRISIS	-0.087	0.145		0.178	-0.072
	(-6.332)	(3.396)		(3.990)	(-2.095)
DPEN	0.086	0.190	-0.066		-0.112
	(-6.011)	(4.332)	(-1.869)		(-2.658)
LIGAE	-0.143	-1.532	-1.069		
	(-1.739)	(-5.845)	(-5.149)		
LIPC		-0.107	0.664		
		(-1.803)	(12.556)		
LTOR		0.059	0.103		
		(2.038)	(4.003)		
R2	0.927	0.917	0.883	0.962	0.872
Adj. R2	0.925	0.914	0.878	0.960	0.868
S.E. of reg.	0.038	0.116	0.104	0.125	0.098
DW stat	0.566	0.396	0.450	0.658	0.698
F-statistic	449.3	259.8	211.9	738.8	201.5
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000

t-statistics in parenthesis

With respect to the financial intermediation, a positive sign related to the financial pension assets and financial savings was found. The magnitude of this relation implies that 10% increase in pension fund assets is related to almost 2% increase in financial savings. This effect is corroborated with the positive sign of the dummy variable DPEN.

The ADF test applied to the residual series from this long-run regression proves the existence of a cointegration relation between the variables in the long run. The error correction model illustrates that the lagged residual has a significant and negative sign, with a coefficient of 0.05, which indicates that

financial savings auto-corrects towards its long-run equilibrium slowly. In the short run, an overall positive effect was found related to pension fund assets and AFI.

As was stated above, a second estimation with the financial intermediation measure as the dependent variable was conducted. Following Corbo - Schmidt Hebbel (2003), we estimate a cointegration vector to measure financial development that includes a variable to account for the importance of the pension funds for the system created with the 1997 reform. In this system two types of variables were included: a structural reform variable which takes into account financial liberalization process and variables that in simple models are important for the relative demands of the different financial assets.

In this estimation, AFI measures the level of financial depth and is the sum of the main financial assets in the economy[32].

Table 5
Alternative estimation of
Pension fund assets and AFI

	LAFI
C	17.826
	(213.503)
LPFA	0.216
	(41.799)
DINF	-0.157
	(-13.654)
DPEN	0.097
	(-7.312)
LFINLIB	0.007
	(2.519)
LOPEN	-0.138
	(-6.777)
D04	0.102
	(10.816)
R2	0.983
Adj. R2	0.983
S.E. of reg.	0.029
DW stat	0.853
F-statistic	1396.9
Prob(F-statistic)	0.0000

t-statistics in parenthesis

The variable accounting for the pension reform is the pension fund assets variable in real terms (AFI). Corroborating the previous result, a positive relation of the amount of resources in the pension system and the financial savings was found. A positive effect was found of the variables related to the

[32] According to Bank of Mexico monetary aggregates, M3a is M2a plus domestic financial assets held by non-residents. M2a comprises currency outside banks, domestic currency checking accounts in resident banks, foreign currency checking accounts in resident banks, current account deposits in resident banks, domestic financial assets held by residents, and domestic financial assets held by non-residents.

pension reform dates and the important changes in the legislation in 1997 and 2004, respectively. The structural reform variable was constructed with the aim of measure the financial liberalization process during the last years. For the construction of this variable, the number of financial law reforms for each year was taken into account with special attention being paid, to the financial reforms related to the pension system[33].

As for the banking industry, the ratio of domestic credit provided by banking industry to GDP (FBCGDP) was considered. The inclusion of this variable is with the aim of measure whether with pension fund assets' growth, the traditional commercial banking industry has declined its relevance compared to other financial institutions.

As it can be seen from Table 4, the coefficient of LPFAGDP on credit (LFBCGDP) is negative, implying that domestic credit provided by banking sector across the sample is declining in the long run while in the short run the effect is mixed. The negative effect founded reflects the declining tendency on the credit provided from commercial banks to the private sector in the lasts years and the importance that in these years other financial intermediaries have had[34].

The coefficient of DLPFAGDP is 0.72 in the short run (impact), positive and significant, suggesting that pensions induce financial development by facilitating saving transfer. However, as was previously said, the long run effect is negative. We also found a negative (but weakly significant) effect of stock market on the dependent variable while the coefficient of the stock market turnover is positive and significant.

In this estimation, a positive relationship of stock market development on credit lending by banks in the long run. This effect supports the idea of financial accelerator hypothesis which is especially observable for emerging markets where the higher net wealth of individuals leads to more banking lending which in turn stimulates economic growth.

The residual of this regression are stationary, implying the existence of a long run relationship among the variables. The variable related to the error correction mechanism is negative and statistically significant and for its magnitude (0.039) can be said that the adjustment process of the dependent variable process after a shock is slow.

Results of pension fund assets' impact on stock market are given in the same table (Table 4). Stock market capitalization (LVMVGDP) is the most frequently used variable, and measure the overall size of markets. A significant – but

[33] As was discussed in section 3.2.2, during 2004 important changes to Siefores' investment regime were approved.

[34] Non-bank lending represents a bigger amount of resources to the private sector. The sources for the non-bank lending are financial institutions such as (SOFOLES), credit unions, leasing and factoring enterprises. It also includes non bank liabilities of companies listed in the Mexican Stock Exchange Market and other securities and credit card of others non-bank lending and department stores

negative – effect related to the pension fund asset was found for the long run. A possible explanation of this result is the small sample size for which pension fund assets can be invested in equities due to past regulation. However, the effect in the short run is positive and important in magnitude.

As indicated by the sign of coefficient of lagged inflation, there is sign of the negative impact of macro-instability on stock market capitalization. In the same sense, interest rate shows negative sign, implying the opposite movement of interest rate and stock market. These results are in line with Hu (2005) estimation for a group of emerging markets economies.

Finally, we consider returns on bonds, as for pensions' impact on the public bond market (VPUPRAFI), the results presented in Table 4 are in favour of a positive relationship with pension fund assets both in the long run and in the short run. This positive sign can be related to the willingness of government to use pension funds to finance implicit pension debts and although less important proportion of pension funds is invested in government bonds, the amount is still important[35]. Concerning other explanatory variables, there are negative effects of inflation on public bond markets implying the importance of macro-stability in maintaining financial markets. Compared with other financial development indicators, the speed of adjustment of the public bonds to its long run equilibrium is fast, and indicates that the dependent variable auto-corrects by approximately 2/10 each period.

Regarding the private bond market (VPRPRAFI) the estimation in levels shows a negative sign related to the pension system assets in the long run, however in the short run the relation is positive and statistically significant. This result is consistent with the expectation of a more developed private bond market following a pension asset growth.

[35] The details with respect of the composition of the funds invested by SIEFORES are in the section 3.2.2 of this paper.

5 Conclusion

Global life expectancy at birth is estimated to have risen from 47 years in 1950-1955 to 65 years in 2000-2005, and is estimated to keep increasing to reach 75 years by 2050. This population aging will occur faster in developing countries. On the other hand, the proportion of the population in working age is expected to decline in the future. These combined processes imply important policy challenges related to social institutions from labour and capital markets to health and pension systems.

In the case of pension systems, the challenge have implied in many countries around the globe the structural reform, form unfunded PAYG to funded FF schemes. In this context, Latin America is the region with the largest number of countries with reformed pension system in the world.

In the case of Mexico, the aging process of the population is also very important: while in 1990 life expectancy at birth was 71 years, it has increase to 74 years in 2005 and is expected to be 81 by the year 2050. In that year, the population with 60 or more years will represent almost 28% of total population, in contrast to the today's 7.7%.

The structural reform in the Mexcian poension system began in 1997, when the old defined benefit program began to be subsituted for a defined contribution fully funded scheme. The new system is mandatory for all the private sector workers and the funds are administed by specialized private companies.

It has been argued that a pension reform can have an important effect on financial market development as long as pension fund assets can be invested in a variety of assets, because the reform imporves the performance of the functions of financial market development and can improve the functions of the financial markets. In this sense, funding may increase portfolio investment, reducing the volatility of returns.

The aim of this paper was to investigate the implications for the Mexican financial system of the structural reform of the pension system that began in 1997.

On the other hand it has been analized in the empirical literature the positive link between financial markets development and economic growht. This result is supported by the idea that better functioning financial intermediaries improve resource allocation and accelerate total factor productivity growth with positive reprecusions for long-run economic growht. Taking into account these results, the structural reform on the pension system in Mexico could lead to both direct and indirect positive effects overall macroeconomic performance.

We employed a cointegration technique to explore in the light the existence and significance of a long-run relationship among pension fund assets and financial development indicators. From a variety of estimations, pension reform as a percentage of GDP were found to positiveley and significantly affect financial development.

In particular, the effect of pension fund assets on financial development was analized trough four aspects: finanical intermediaries, represented by financial savings as a percentage of GDP as the dependent variable, the banking industry, represented by domestic financing by commercial banks as % of GDP, the stock market measured by stock market capitalization as % of GDP and bond market, measured by both public and private securities held by residents as % of financial savings.

We found that higher pension assets are associated in the long-run with financial savings, which is consitent with the fact that pension fund may act as a institutional investors managing the increased personal savings. With respect to the banking industry, a negative long-run relationship was found. This negative sign can be explained by the declining trend on the credit provided from commercial banks to the private sector and the rise in importance of other financial intermediaries.

Results of pension fund assets on stock market capitalization is significant but negative. A possible explanation of this result is the small sample size for which pension fund assets can be invested in equities due to past regulation. This same explanation can be valid in order to explain the negative sing founded for the long-run relationship between pension fund assets and private sector securities held by residents.

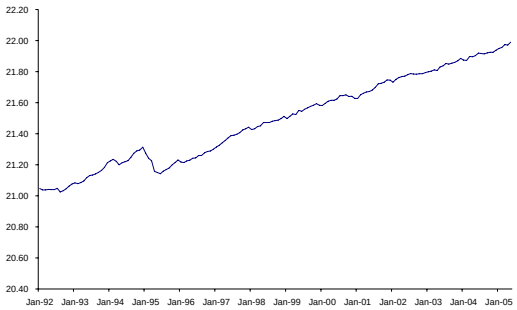
The analysis conducted here was intended to be a approximation to the effect of the relativleley recent pension system structural reform in Mexico. As was described in section 3.2, the regulation on the new system has been continuously improving in several areas: allowing investment in forgein instruments, introducing measures to improve market competition, strengthening the investment risk framework, etc. Due to the relativeley small number of obervations and these changes in regulation, there can be economic implications that this investigation could have been misscaptured.

6 Appendix

Appendix A

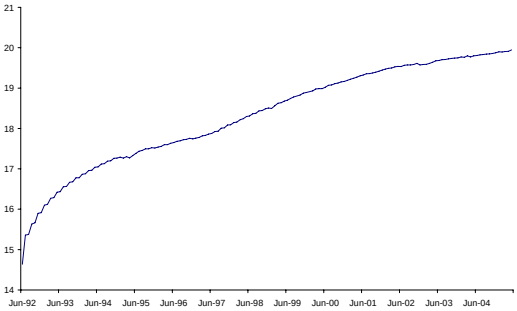
Variables included in the empirical analysis*/

Financial Savings
(LAFI2)



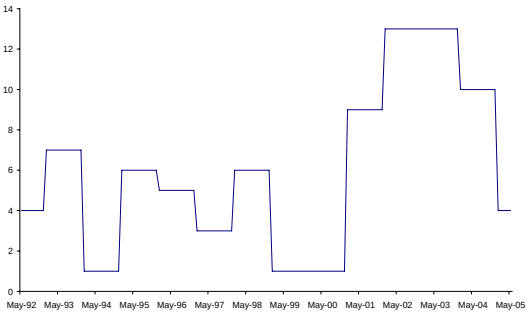
Source: Bank of Mexico

Pension Fund Assets
(LPFAR)



Source: Bank of Mexico

Economic Reforms
(FINLIB)



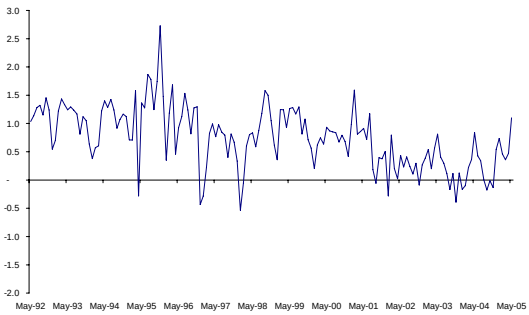
Short Run Public Interest Rate
(LCT28)

Source: Bank of Mexico

3-Month Treasury Bill
(3MTB)

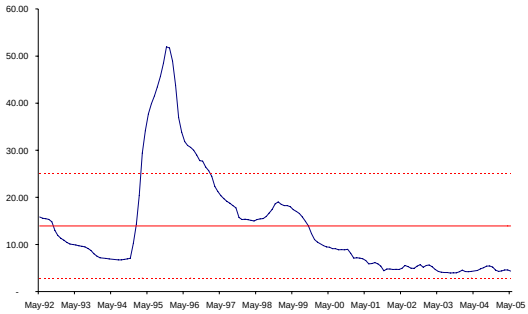
Source: Federal Reserve Bank

Short Run Private Real Interest Rate
(PPCCPR)



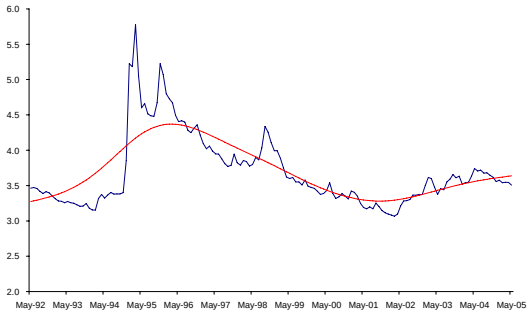
Source: Bank of Mexico

Inflation Rate
(INF)



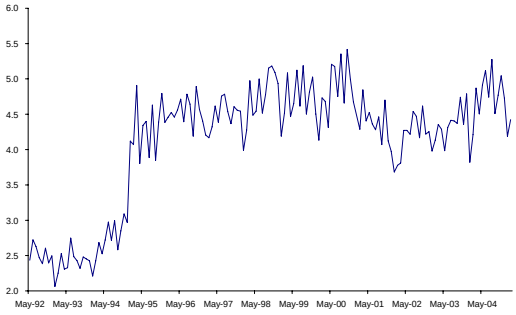
Source: Bank of Mexico

RER and HP-RER
(GPRER)



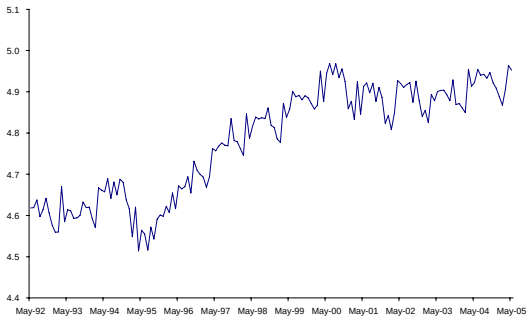
Source: Bank of Mexico, Federal Reserve and Hodrick-Prescott Filter

Openess
(OPEN)



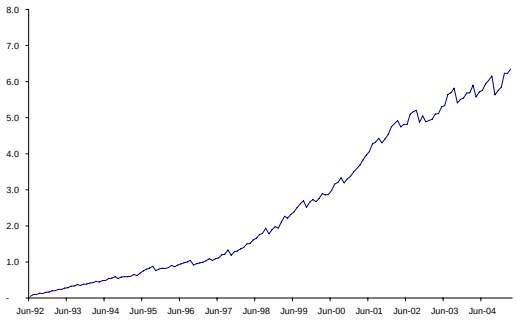
Source: National Institute for Geography and Statistics, Mexico.

Production Index
(LIVPFI)



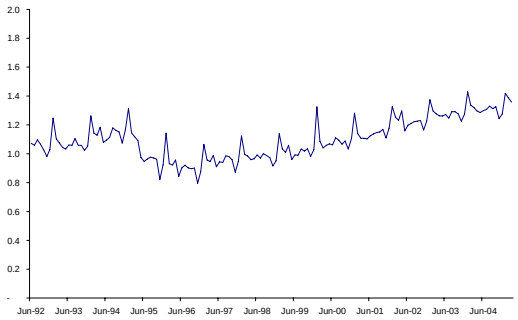
Source: National Institute for Geography and Statistics, Mexico.

Pension Fund Assets as % of GDP
(LPFAGDP)



Source: Bank of Mexico and National Institute for Geography and Statistics, Mexico.

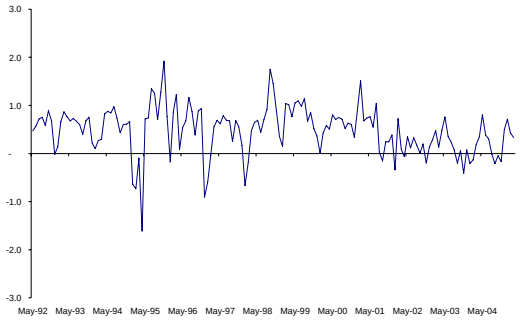
Currency as % of GDP
(LBYMGDP)



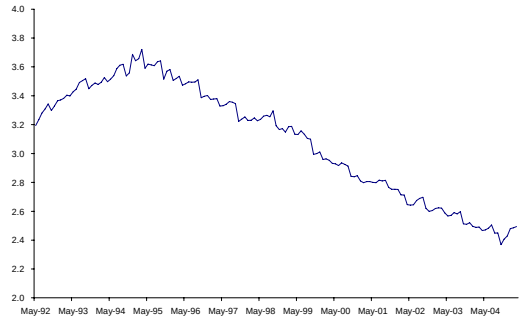
Source: Bank of Mexico

Real Interest Rate

Domestic financing by commercial banks % of GDP (FGCGDP)

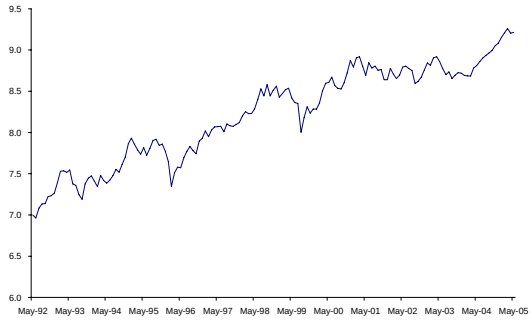


Source: Bank of Mexico



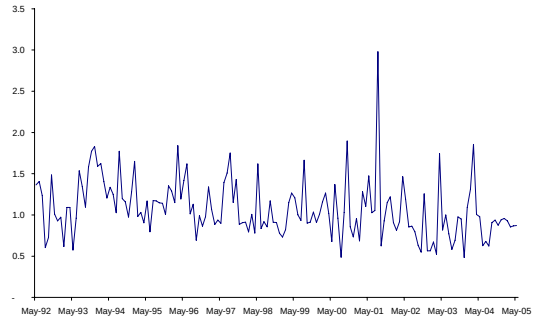
Source: Bank of Mexico

Mexican Stock Market Index (LIPC)



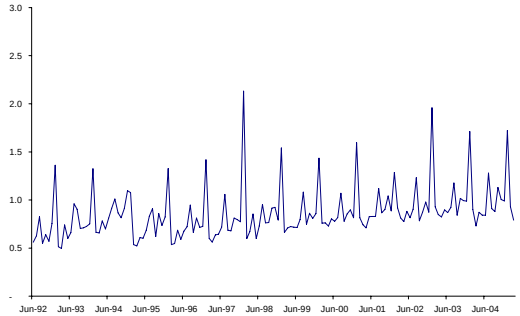
Source: Bank of Mexico

Stock Market Turnover (LTOR)



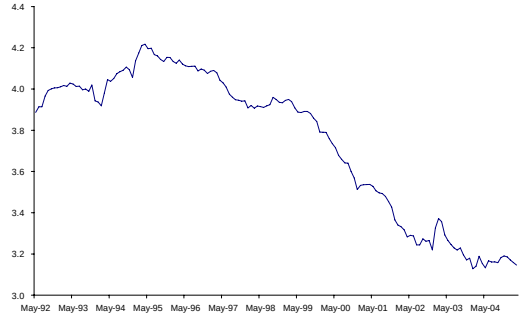
Source: Bank of Mexico

Government Expenditures as % of GDP (GPGDP)



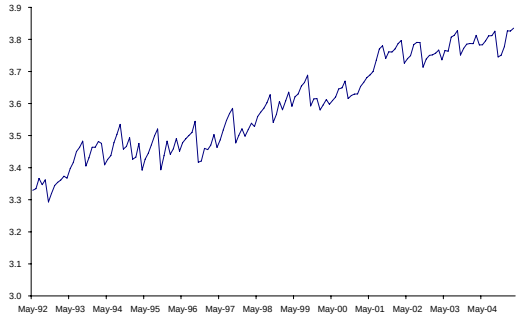
Source: Ministry of Finance

Deposits in resident banks as % of total financial savings (LCIBRAFI)



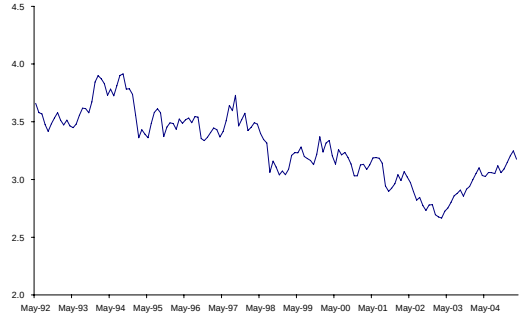
Source: Bank of Mexico

Financial Savings as % of GDP (LAFIGDP)



Source: Bank of Mexico and National Institute for Geography and Statistics, Mexico.

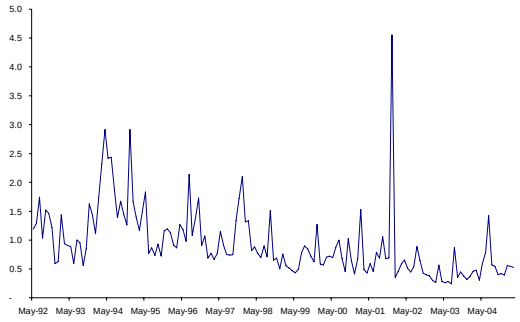
Stock Market Capitalization as % of GDP (LVMVGDP)



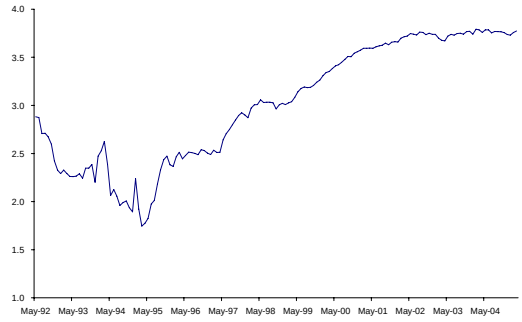
Source: Bank of Mexico

Stock Market Value Traded as % of GDP (OMBGDP)

Public securities held by residents as % of financial savings (LVPUPRAFI)



Source: Bank of Mexico

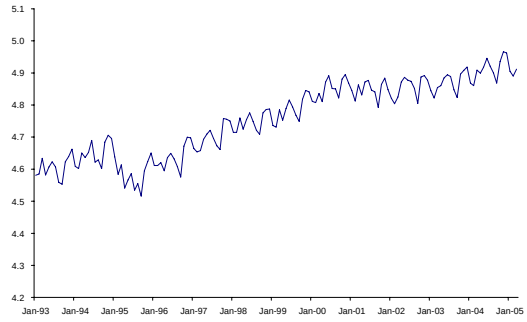


Source: Bank of Mexico

Private sector securities held by residents as % of financial savings (VPRPRAFI)

Source: Bank of Mexico

Global Index of Economic Activity (LIGAE)



Source: National Institute for Geography and Statistics, Mexico.

*-/ The “L” before each variable name implies that the data are on logaritmic scale.

Appendix A

Short run relationships

Short run regression of the relationship between pension fund assets and economic indicator is presented in the next Table.

Table 3.A

Pension fund assets and economic indicator
Short run relation

Based on Hu (2005)		Based on Corbo and Schmidt-Hebbel (2003)	
	DLIVFPI		DLAFI
C	0.001	C	0.004
	(0.648)		(3.960)
DLY(-1)	-0.453	DLY(-3)	0.250
	(-6.302)		(3.479)
DLPFAGDP(-3)	-0.045	DPRER(-1)	-0.015
	(-1.561)		(-2.474)
DLFBCGDP	-0.243	DPRER(-3)	-0.040
	(-4.240)		(-5.211)
DLFBCGDP(-3)	0.176	DLCT28	-0.014
	(2.667)		(-2.016)
DLFBCGDP(-4)	0.163	DLCT28(-3)	0.019
	(2.882)		(2.108)
DLOPEN	0.280	DLCT28(-4)	-0.022
	(10.372)		(-3.317)
DLOPEN(-1)	0.194	DLINF	-0.045
	(5.997)		(-3.031)
DLINF	-0.095	DTB3M	0.009
	(-3.328)		(1.711)
DLCT28	-0.034	DINF	-0.005
	(-2.294)		(-1.697)
DLCT28(-1)	-0.039	ECM(-1)	-0.071
	(-2.554)		(-2.109)
DLCT28(-3)	-0.037		
	(-2.779)		
ECM(-1)	-0.270		
	(-4.627)		
R2	0.710	R2	0.535
Adj. R2	0.685	Adj. R2	0.501
S.E. of reg.	0.070	S.E. of reg.	0.016
DW stat	1.621	DW stat	1.992
F-statistic	27.811	F-statistic	15.551
Prob(F-statistic)	0.000	Prob(F-statistic)	0.000
t-statisitc in parenthesis		t-statisitc in parenthesis	

Table 4.A
Pension fund assets and financial indicators. Short run relation.

	DLAFIGDP	DLFBCGDP	DLVMVGDP	DLVPUPRAFI	DLVPRPRAFI
C	-0.005	-0.015	-0.012	0.011	-0.004
	(-3.240)	(-7.404)	(-4.676)	(1.627)	(-1.032)
DLY(-1)					
DLY(-2)			0.252		
			(3.857)		
DLY(-3)			0.144		0.094
			(2.750)		(1.303)
DLY(-4)				0.209	0.194
				(3.030)	(2.703)
DLPFAGDP	0.700	0.721	0.699	-0.196	
	(23.413)	(18.953)	(14.167)	(-1.908)	
DLPFAGDP(-1)				0.210	
				(1.913)	
DLPFAGDP(-2)	-0.224	-0.224	-0.495		0.261
	(-8.149)	(-5.700)	(-8.494)		(3.269)
DLPFAGDP(-3)				-0.184	
				(-2.491)	
DLPFAGDP(-4)	-0.123	-0.111			-0.126
	(-4.822)	(-3.099)			(-2.259)
DLIGAE	-0.091		-0.285		
	(-2.574)		(-4.329)		
DLIGAE(-4)		0.102	0.718		
		(2.092)	(32.539)		
DLIPC(-2)			-0.139		
			(-2.610)		
DLIPC(-3)			-0.093		
			(-2.096)		
DLFBCGDP					
DLFBCGDP(-3)					
DLFBCGDP(-4)					
DLOPEN					
DLOPEN(-1)					
DLINF					
DLINF(-1)			-0.061		
			(-2.572)		
DLINF(-4)				-0.148	
				(2.349)	
DLCT28		0.052	-0.042	-0.177	-0.066
		(4.644)	(-3.405)	(-5.092)	(-2.596)
DLCT28(-1)	-0.014			-0.065	
	(-1.745)			(-1.887)	
DLCT28(-3)	-0.033	-0.045			
	(-4.030)	(-4.035)			
DLCT28(-4)			0.033		
			(2.690)		
DLTOR(-3)					-0.024
					(-2.523)
DLTOR(-4)					-0.016
					(-1.685)
ECM(-1)	-0.055	-0.039	-0.022	-0.209	-0.163
	(-1.639)	(-2.484)	(-1.238)	(-4.590)	(-4.095)
R2	0.849	0.752	0.935	0.389	0.259
Adj. R2	0.841	0.739	0.930	0.354	0.217
S.E. of reg.	0.028	0.020	0.057	0.504	0.294
DW stat	2.022	2.017	1.938	2.073	1.974
F-statistic	110.947	58.776	160.693	11.210	6.152
Prob(F-statistic)	0.000	0.000	0.000	0.000	0.000

t-statistic in parenthesis

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